Neandertal vs. Modern Human

A Look at Skeletal Traits

INTRODUCTION

Since the initial discovery of Neandertals there has been an ongoing debate about their phylogenetic position in evolution. Are they or are they not a separate species from the modern human? In the past, Paleoanthropologists have used metric and morphological differences to validate claims that European Neandertals belong to a different species than modern Homo sapiens. Such assertions were based on a complied list of characteristics considered to be autapomorphus to the European Neandertal. From these so-called "conclusions" a series of speculative evolutionary models came into being in an attempt to explain extinct groups. However, due to the growing number of Neandertal remains, Paleoanthropologists have recently begun to reevaluate the accuracy of the characteristics once thought to be singularly Neandertal. Through the analysis of the Horizontal-Oval (H-O) foramen and the retro-molar space, both occurring on the mandible, I was able to compare the frequency of two purportedly unique traits among European Neandertals, Early and Late Upper Paleolithic, Mesolithic and modern humans, as well as chimpanzees and gorillas.

BACKGROUND

Neandertals appeared during the Mousterian period lasting from 70,000B.C.E. to 40,000 B.C.E. when they mysteriously disappeared. One of the main models tackling their disappearance is the Recent African Origins model or Out of Africa. This model argues that modern humans first arose in Africa about 100,000 years ago and spread from there throughout the world. Most important to Paleolanthropologists is the notion that indigenous pre-modern populations in other areas of the world were replaced by the migrating populations with little, if any, hybridization between the groups.[1] According to this model, distinctive regional features of archaic *Homo* species in other areas were not incorporated into modern human populations that eventually replaced them. Therefore no trait considered to be unique to Neandertals should show

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up among modern human skeletal remains.

The opposing side to this argument is the Multiregional Evolution model. This model differs from the first by denying a recent African origin for modern humans and instead emphasizes the role of both genetic continuity over time and gene flow between contemporaneous populations in arguing that modern humans arose not only in Africa but also in Europe and Asia from their Middle Pleistocene forbearers.[2] In other words, unique regional features connect modern and archaic humans in each region through derived and retained archaic characteristics.[3] This allows for Neandertal traits to be passed onto modern humans without conflict based on the assumption that the two groups are of the same species. However, the purpose of this paper is not to argue which world-population theory is correct, but rather to look objectively at two traits found in the skeletal material commonly used to support each side of the argument.

The first purportedly unique trait I will look at is the horizontal-oval (H-O) foramen type. This trait is identified by the anterior and posterior borders connected by a broad band of bone which appears to be a posterior extension of the mandibular lingula.[4] When present, the H-O is distinct enough that it cannot be mistaken for bridging of the mylohyoid sulcus, which occurs inferior and anterior to it. Paleoanthropologists have agreed that such a trait is a deviant form of the normal V or U-shaped foramen.[5] This foramen functions as the entrance to the mandibular canal through which the inferior alveolar branch of the mandibular division of the 5th cranial nerve and accompanying vessels pass.[6] Soft tissue, known as the sphenomandibular ligament, surrounding the area has been shown to be responsible for stabilization and

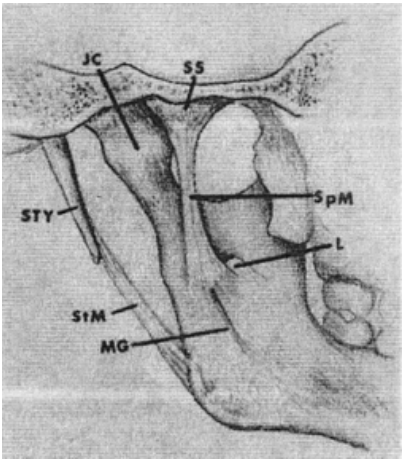

FIgure 1. The position of the sphenomandibular ligament (SpM) and other associated structures in man: the lingula (L), spine of the sphenoid (SS), joint capsule of the TMJ (JC), styloid process (STY), stylomandibular ligament (StM), and mylohyoid groove or sulcus (MG) (Smith 1978).

inserts very closely to the mylohyoid sulcus on the interior of the mandible. The ligament attaches the mandible to the underneath of the cranium as seen in Figure 1. Scholars believe that it is probable for the "abnormal" trait to have benefited not harmed the carrier. By expansion of the bony area, the distance between the mandibular and cranial insertion points is reduced creating a more solid anchoring for the ligament. Although modern doctors can make assumptions as to the function based on information gathered during autopsies, reasons for why the trait has occurred in some and not in others is still a mystery.

The second purportedly unique trait I will examine is the retro-molar space. This trait is identified by a space or gap at the rear of the mandible between the back of the [third] molar and the anterior edge of the ascending ramus where it crosses the aveolar margin.[7] Considered to be

one of the more important traits when it comes to separating Neandertals and modern humans as different species, the retro-molar space is seen as a requirement for the midfacial prognathism necessary to maintain the functionality of the upper and lower teeth.[8] An example of this trait can be seen in the Neandertal mandible in Figure 2.

Renewed interest in the H-O foramen type began with the research Smith (1978) carried out focusing on Krapina remains. Of the nine mandibles he examined, three displayed the H-O foramen type. After expanding his sample size to include Near Eastern material he discovered five additional carriers putting the total at 8 individuals out of the 22 examined as seen in Table 1. In addition to Neandertal material he also recorded incidences of the trait on European Upper Paleolithic hominids. Of the ten examined, only Predmostì 3, 4 and Vindija 207 exhibited the trait as seen in Figure 3.

Frayer (1992) expanded on Smith's research by examining greater numbers of European Neandertal remains for the H-O foramen type and looked at trends between Early and Late Upper Paleolithic, Mesolithic and a set of modern human remains belonging to a group of Medieval Hungarians. Of the groups studied, European Neandertals showed the highest frequency with 10 out of 19 individuals displaying the trait. Among 22 Early and 30 Late Upper Paleolithic individuals the trait presented itself in four and two individuals respectively. In skeletal material dating to the Mesolithic period, three individuals from the total 161 displayed the trait. Additionally, the trait was also discovered in three individuals from the 208 member Medieval Hungarian group. However, the one sample from the Skhul/Qafzeh group and two samples belonging to African "Eves" from Border Cave and Klasier River Mouth, showed no presence of the H-O foramen type as seen in Table 2.

For the Retromolar space, Trinkaus (1987) lists five specimens (Krapina 57, La Naulette 1, La Quina 9, Vindija 206, and Hortus 4) as lacking the "typical" trait.[9] Despite

Figure 2. (below) Krapina 59 Mandible J- Left side

Figure 3 (right) Krapina 63- right Ramus showing clear H-O foramen type.

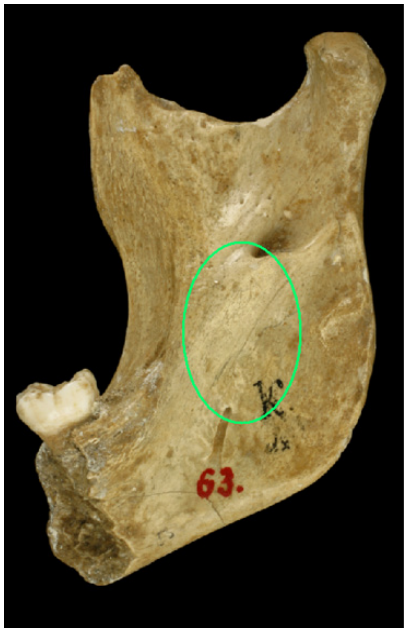

Table 1. Form of the lingula-mandibular foramen area in Neandertals listed by individual specimen. A plus (+) indicates presence of the H-O type. A minus (----) indicates a normal mandibular foramen. An I indicated an indistinct morphology. An X indicates absence of the area on the specimen. Source for observation: (A) original fossil, (B) cast, (C) photograph, (D) personal communication from Dr. T. D. Stewart (Smith 1978).

Specimen:	Source:	Side: Left	Side: R
Krapina 53	A	X	----
Krapina 59	A	+	+
Krapina 63	A	X	+
Krapina 64	A	X	----
Krapina 65	A	X	I
Krapina 66	A	+	X
Krapina 67	A	----	X
Krapina 68	A	+	X
Krapina 69	A	----	X
Teshik Tash (j)	B	----	----
Gibraltar (j)	B	X	----
La Chapelle	B-C	----	----
La Quina H5	B	+	+
La Ferrassie I	B-C	+	+
Le Moustier	B	+	I
Ehringsdorf	B	X	I
Circeo 2	B	X	I
Circeo 3	B	X	I
Tabun I	B-C	----	----
Tabun II	B-C	+	+
Shanidar I	D	----	----
Shanidar II	D	X	----

Table 2. Mandibular foramen types in European Neandertals, Skhul/Qafzeh, Early Upper Paleolithic, Late Upper Paleolithic, Mesolithic and Medieval Hungarians (Frayer 1992)

Specimen:	Horizontal-Oval % (N):	Normal % (N):
European Neandertals	52.6 (10)	47.4 (9)
African "Eves"	0.0	100.0 (1)
Skhul/Qafzeh	0.0	100.0 (2)
Early Upper Paleolithic	18.2 (4)	81.8 (18)
Late Upper Paleolithic	6.7 (2)	93.3 (28)
Mesolithic	1.9 (3)	98.1 (158)
Medieval Hungarians	1.4 (3)	98.6 (205)

Table 3. Recordings of the presence or absence of the retro-molar space according to Trinkaus, Wolpoff, Frayer 1992. A plus (+) indicates presence of the retro-molar space on at least one side. A minus (----) indicates no presence of a retro-molar space on either side.

Specimen:	Retro-molar trait:
Krapina 57	----
La Naulette 1	----
La Quina 9	----
Vindija 206	----
Vindija 207	+
Hortus 4	----
Predmostì 3	+
Predmostì 4	+
Predmosti 21	+
Brno 2	+
Skhul 5	+
Qafzeh	----
African "Eves"	----

expectations of researchers that the retro-molar trait should be absent in Upper Paleolithic hominids, Wolpoff (1981) describes that very trait in the Vindija 207 mandible associated with that time period. Other examples were described in Predmosti 3, 4, and 21, as well as Brno 2.[10] With the exception of Skhul 5, none of the Qafzeh nor any remains attributed to African "Eves" have been found to carry the trait as seen in Table 3.[11] However, all of this research done on Neandertal and Paleolithic groups would be for nothing, had somebody not collected information for the frequency of these traits in modern human populations.

In 1911, Ohio laws changed to allow professors of anatomy to retain skeletal and other material specimens from the cadavers dissected by their medical students. A year later, T.W. Todd seized this opportunity with his appointment as professor of anatomy to Western Reserve University and began collecting the material.[12] At the time of his death in 1938, the collection contained records of over 3,600 cadavers and over 3,000 skeletons.[13] These materials were supported by extensive documentation, thus creating the largest modern documented human skeletal collection in the world. Carl Hamann, Dean of the Western Reserve University School of Medicine, was instrumental in assisting Todd in the building of the collection. In addition there are 1,216 specimens in the non-human primate collection. Of these, 967 specimens are represented by cranial or postcranial skeletal remains. Smaller primates were purchased through Gerrard and Sons in London while larger primates were purchased from a private collector.[14] The skeletons in the University's collection were transferred to The Cleveland Museum of Natural History during the 1950's and 1960's. With the opening of the Physical Anthropology Lab at the Museum, this collection has become one of the most researched museum collections in the world and the prime location for carrying out my own research.

DATA

Due to the large size of the collection, I pulled ten specimens from each number bracket consisting of 100 specimens in order to get a more varied sample. From there, samples were examined for the presence of intact rami so that the mylohyoid sulcus was clearly visible and a reading of the H-O trait could be taken. If missing or damaged the sample was replaced and another specimen was used. In total 500 human and 100 non-human primate samples were used. During examination of each specimen the left and right side were considered separately. Therefore if a sample displayed the trait on the left but not the right, the presence was still marked.

Readings for the presence or absence of the retro-molar space

Figure 4. HTH 0303 (left) showing the normal V-shaped foramen and HTH 0301 showing the anomalous H-O foramen type.

Figure 5. HTH 183 (left) displaying the retro-molar space and HTH 171 (right) with normal spacing.

were taken concurrently with the H-O analysis. Unfortunately, due to the lack of preservation of the third molars, many of the samples were not able to be used. In total, only 130 human and 75 non-human primate samples met the criteria. During examination, each specimen was rotated 90 degrees so that the ascending and horizontal rami were flat. This was measured by holding a line level on each area to ensure the proper angle. If needed, adjustments were made and each area was re-measured. Once this was done specimens with a noticeable gap were further tested by placing the head of an unsharpened no. 2 pencil in the area. If big enough to fit, the specimen would be recorded as having the trait. As with the previous trait, the presence of the retro-molar space was also considered separately for left and right sides. In addition, due to the reliance on retained erupted third molars all children were excluded from the study.

The modern human sample used for the study was made up of mainly European-Americans and African-Americans. Although a few Asian-Americans were recorded, they will not be discussed in this paper due to their small proportion in the overall collection. Much like the Neandertals, human specimens carrying the trait are easily detectable in most cases as seen by the comparison of the normal V-shaped foramen with the anomalous H-O type seen in Figure 4. Of the 394 male mandibles studied, 15 European-Americans were found to exhibit the H-O trait, while African-Americans showed much lower frequencies with only three representations found. Noticeably, of the 106 female mandibles examined, European-Americans and African-Americans each contained two representations as seen in Table 4.

Males once again continued to

Figure 6. HTB 1078 (left) gorilla showing the H-O foramen type and HTB 1998 (right) gorilla showing the normal V-shaped foramen.

Figure 7. HTB 1723 (left) chimpanzee and HTB 1072 (right) chimpanzee both showing normal foramens.

opportunity brought on by the makeup of the collection offered another area of study. In order to keep things simple I applied the same criteria and measuring procedures to 50 gorillas and 50 chimpanzees. Although orangutan material was available, constraints on time made it impossible to include in my study. Of the 33 male gorillas studied, six displayed H-O traits that looked remarkably similar to those displayed in human mandibles as seen in Figures 6 and 7. None of the 17 females displayed anything resembling the trait. In addition, none of the 20 male or 30 female chimpanzees studied show signs of having the trait as seen in Table 6.

While the H-O trait was stronger in the male primate group, it is the female primate group that seems to display higher frequencies of the retro-molar space than females. Among the 111 male mandibles studied, 49 European-Americans and 19 African-Americans were found to display the retro-molar space. Unlike the H-O trait, the frequency of the retro-molar was higher in African-Americans with seven observed while only one European-American displayed its presence as seen in Table 5. However, it must be brought to one's attention that a total of only 19 females met the criteria to be studied. Similarly to the H-O, observing a positive occurrence of the trait for most specimens was relatively easy due to the size of the gap as seen in Figure 5.

Although not much research has been carried out in the realm of non-human primate research in regards to these traits, the unique

Figure 8. HTB 1723 (left) chimpanzee with retro-molar space and HTB 1072 (right) chimpanzee with normal spacing.

Table 4. Mandibular foramen types in European-American males, African-American males, European-American females and African-American females studied in the Hamann-Todd Collection.

Specimen:	Horizontal-Oval % (N):	Normal % (N):
European-American males	5.3 (15)	94.7 (270)
African-American males	2.8 (3)	97.2 (106)
European-American females	3.8 (2)	96.2 (51)
African-American females	3.8 (2)	96.2 (51)

Table 5. Recording of the presence or absence of the retro-molar space in European-American males, African-American males, European-American females and African-American females studied in the Hamann-Todd Collection.

Specimen:	Retro-molar space % (N):	Normal % (N):
European-American males	71.0 (49)	29,0 (20)
African-American males	45.2 (19)	54.8 (23)
European-American females	20.0 (1)	80.0 (4)
African-American females	50.0 (7)	50.0 (7)

Table 6. Mandibular foramen types in Gorilla males, Gorilla females, Chimpanzee males and Chimpanzee females studied in the Hamann-Todd Collection.

Specimen:	Horizontal-Oval % (N):	Normal % (N):
Gorilla males	18.2 (6)	81.8 (27)
Gorilla females	0.0 (0)	100.0 (17)
Chimpanzee males	0.0 (0)	100.0 (20)
Chimpanzee females	0.0 (0)	100.0 (30)

Table 7. Recordings of the presence or absence of the retro-molar space in Gorilla males, Gorillas females, Chimpanzee males and Chimpanzee females studied in the Hamann-Todd Collection.

Specimen:	Retro-molar % (N):	Normal % (N):
Gorilla males	27.8 (5)	72.2 (18)
Gorilla females	35.3 (6)	64.7 (11)
Chimpanzee males	6.7 (1)	93.3 (14)
Chimpanzee females	15.0 (3)	85.0 (17)

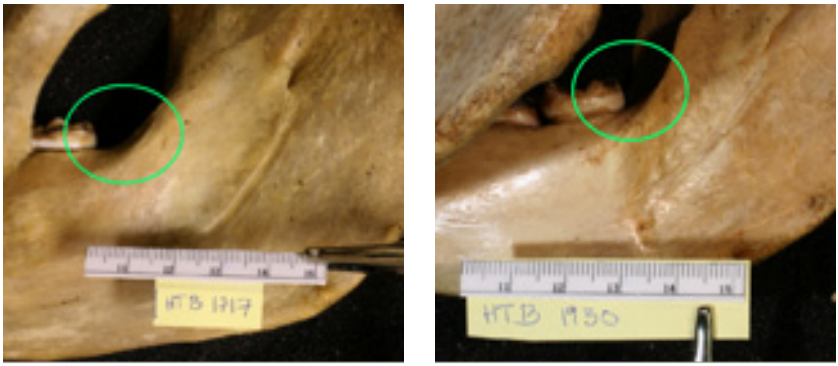

Figure 9. HTB 1717 (left) gorilla with retro-molar space and HTB 1930 (right) with normal spacing.

display stronger frequencies of the retro-molar space. Of the 16 gorilla females studied, six showed clear signs of the trait. Similarly, of the 20 female chimpanzees studied, three display the trait as seen in Figure 8. Five out of the 15 male gorillas also exhibited the retro-molar space as seen in Figure 9. Only one of the 15 male chimpanzees carried the trait seen in Table 7.

RESULTS

From the data gathered by Frayer and presented in Table 2, it is clearly seen that just over half of the material attributed to European Neandertals (52.6%) exhibit the H-O foramen type. One can also see that while the percentage is much lower for Early Upper Paleolithic hominids (18.2%), it is also clearly distinct from the much lower percentiles seen within the Late Upper Paleolithic (6.7%), Mesolithic (1.9%) and Medieval Hungarians (1.4%). In comparison, data from the Mesolithic hominids and Medieval Hungarians are slightly lower than the modern human material in the Hamann-Todd Collection frequencies. Within those frequencies, European-American males (5.3%) had relatively higher occurrences than European-American females (3.8%), African-American females (3.8%) and African-American males (2.8%). While no occurrences of the H-O foramen type were found among male and female chimpanzees as well as female gorillas, it is worth mentioning that the frequencies of the trait found within the male gorilla population (18.2%) is equal to the Early Upper Paleolithic hominid frequency. Thus giving the male gorillas found in the non-human primate Hamann-Todd Collection higher frequencies than Late Paleolithic and Mesolithic groups as well as all of the modern humans studied.

From the research done by Trinkaus, Wolpoff and Frayer, there are at least five European Neandertal and six Upper Paleolithic mandibles in existence that display the retro-molar space. Human skeletal material from the Hamann-Todd collection was found to produce relatively high frequency rates. Notably, European-American males exhibited the highest frequency rate at 71%. This was followed by African-American females (50%), African-American males (45.2%) and European-American females (20%). In the Hamann-Todd non-human primate collection female gorillas were found to display the trait more frequently (35.3%) than their male counterparts (27.8%). Likewise,

female chimpanzees (15%) exhibited higher rates than the males (6.7%). Because the overall non-human primate sample size is relatively small, it would be interesting to see if similar frequencies would occur in a larger sample.

In order to test the accuracy of my recordings, I randomly selected 20 human mandibles that had been previously examined and retested them for both the H-O foramen type and the retro-molar space. There were no discrepancies between the first and second reading for the H-O trait. However, the second readings of the retro-molar trait showed three errors. Two of the errors dealt with individuals being read as negative for the trait the first time around but positive the second time. The error occurred on the left side both times. The third error occurred due to a misread in the teeth. After a second look it was recognized that the individual was missing the second molars and possible re-absorption may have occurred thus making the specimen unfit to use in the study. An additional 10 gorilla mandibles were also retested for each trait towards the end of the study. No discrepancies were seen in the H-O foramen readings or the retro-molar space data.

DISCUSSION

Overall, frequencies found among samples for the H-O trait in modern humans may not have reached over 10%, however the degree is high enough that it merits further consideration and research. In addition, frequencies for the retro-molar space found among modern human material reached numbers as high as 71 %. Although not much is written on gorilla and chimpanzee morphology concerning the two traits, application of research methods to the non-human primate material returned interesting results and creates new grounds for further questioning and research.

While the debate between Paleoanthropologists over the validity of the Recent African Origins model versus the Multiregional Evolution model will continue, one must remember to take non-scientific preconceived notions out of it and look at the hard evidence seen in the skeletal remains. Analyses of mandibles belonging to Upper Paleolithic, Mesolithic and modern humans as well as gorillas and chimpanzees have shown that the two traits discussed are in fact present outside European Neandertals, thus knocking two important characteristics off the list of autapomorphic Neandertal traits that are used to separate them from us. By redefining two major elements of the classification method, the validity of the remaining skeletal traits has been compromised. For now at least, the field of Paleoanthropology can remain certain that there is still much to learn and room for growth.

END NOTES

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